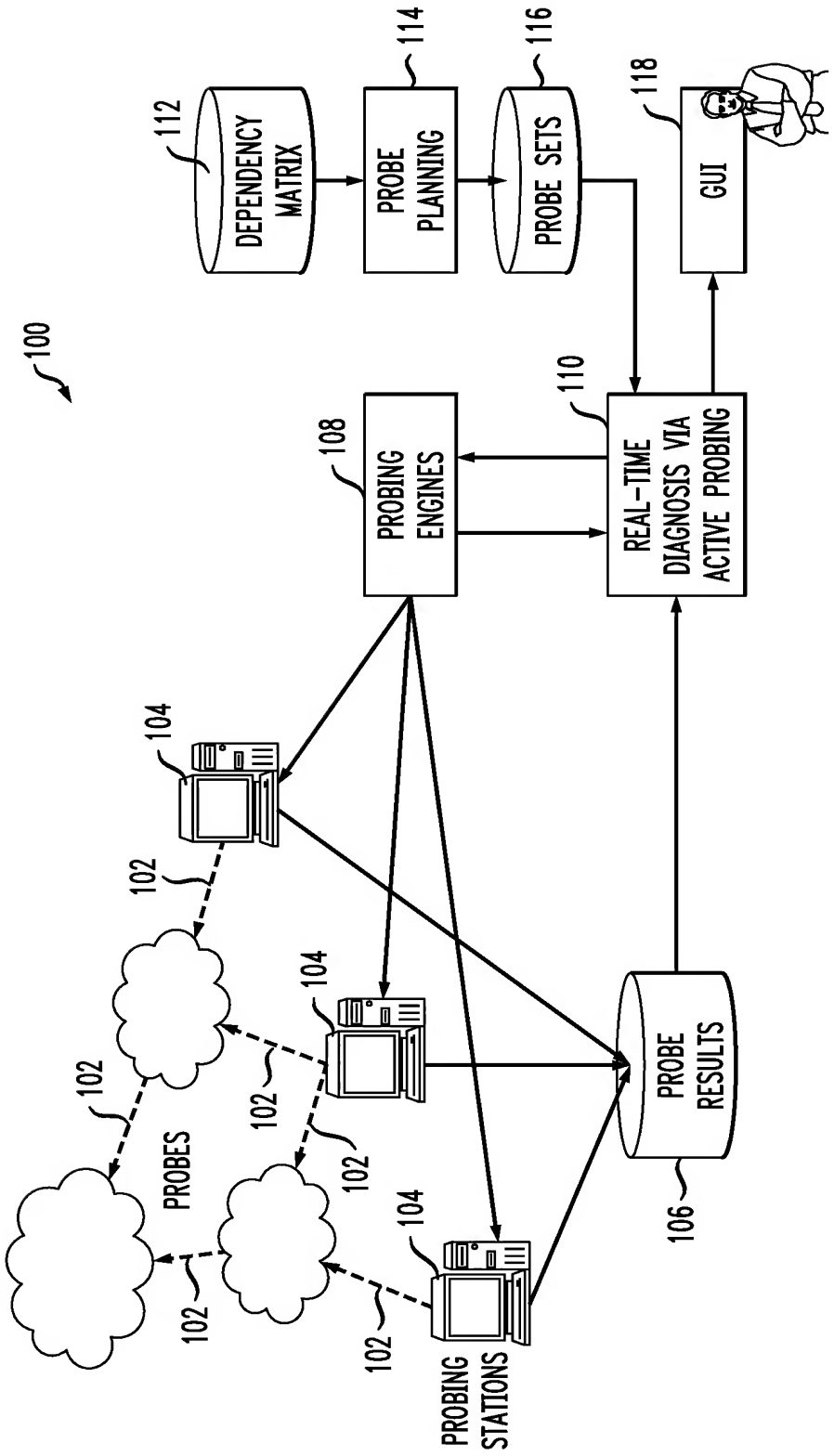

100
112
DEPENDENCY MATRIX
114
PROBE PLANNING
116
PROBE SETS
118
GUI
108
PROBING ENGINES
110
REAL-TIME DIAGNOSIS VIA ACTIVE PROBING
104
102
PROBES
PROBE RESULTS
106
PROBING STATIONS

FIG. 1

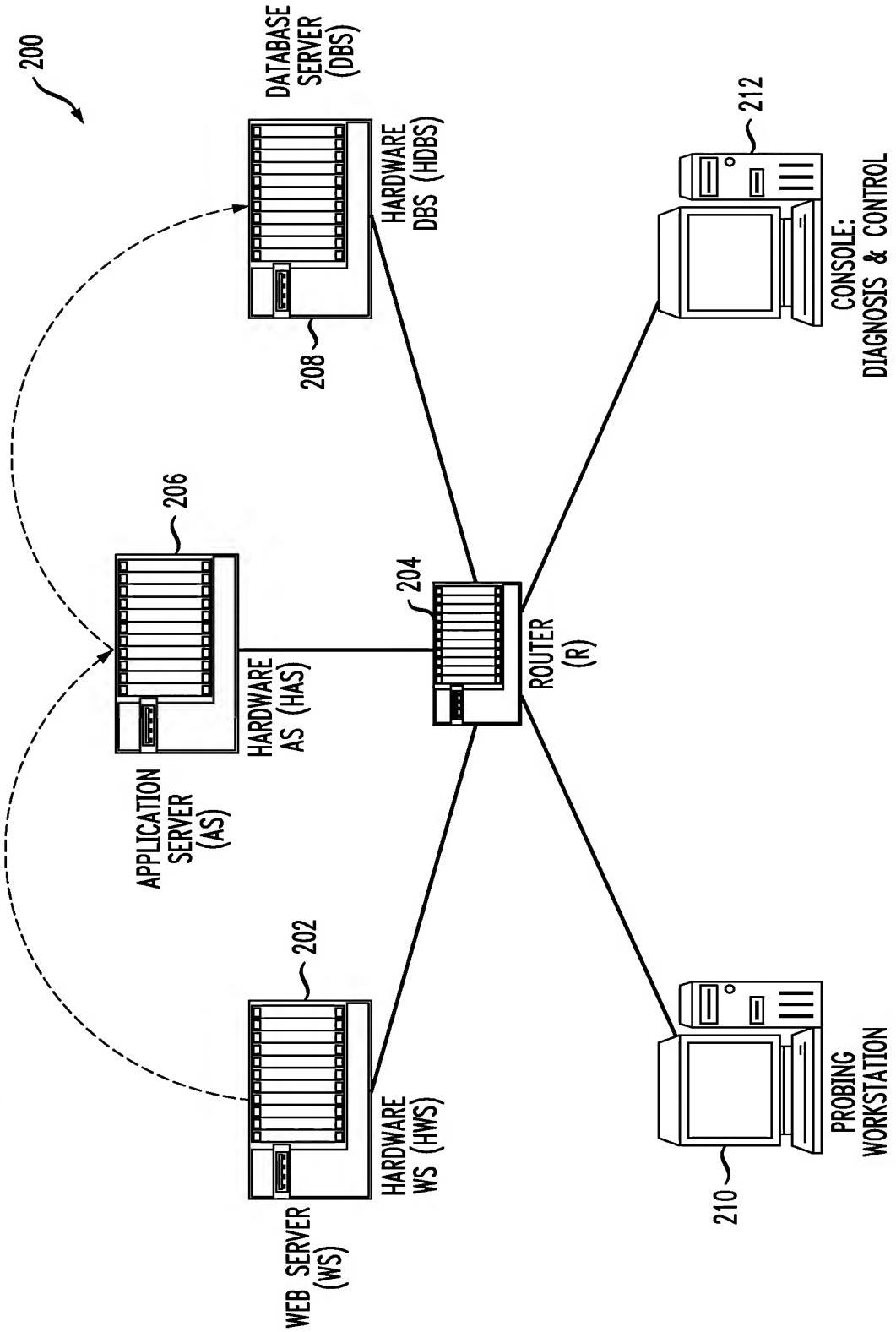

200
DATABASE SERVER (DBS)
HARDWARE DBS (HDBS)
208
212
CONSOLE: DIAGNOSIS & CONTROL
206
204
APPLICATION SERVER (AS)
HARDWARE AS (HAS)
ROUTER (R)
202
WEB SERVER (WS)
HARDWARE WS (HWS)
210
PROBING WORKSTATION

FIG. 2

FIG. 3

DEPENDENCY MATRIX

PROBLEM / PROBE	WS	AS	DBS	R	HWS	HAS	HDBS
pWS	1	1	1	1	1	1	1
pAS	0	1	1	1	0	1	1
pDBS	0	0	1	1	0	0	1
pingR	0	0	0	1	0	0	0
pingWS	0	0	0	1	1	0	0
pingAS	0	0	0	1	0	1	0
pingDBS	0	0	0	1	0	0	1

302 304 300

PROBES:

pWS – WEB PAGE ACCESS
pAS – APPLICATION SERVER ACCESS
pDBS – DATABASE QUERY
pingR – PING ROUTER
pingWS – PING WEB SERVER
pingAS – PING APPLICATION SERVER
pingDBS – PING DATABASE SERVER

FIG. 4

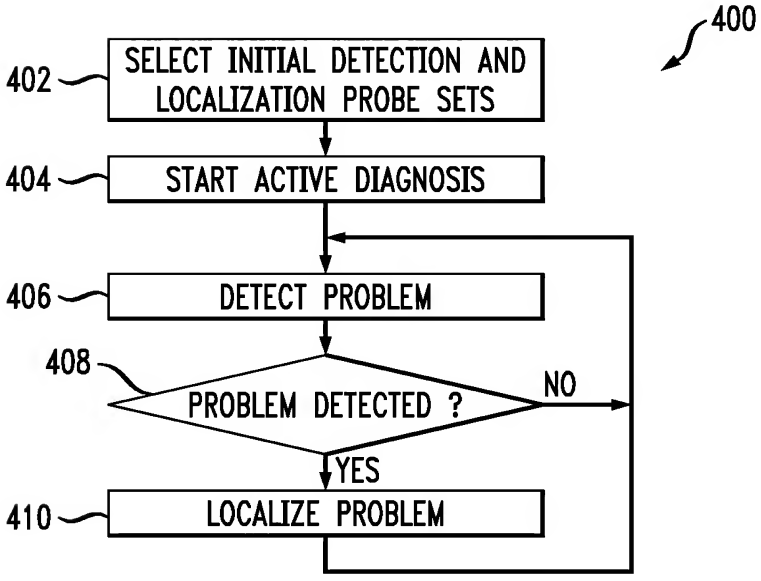


FIG. 5

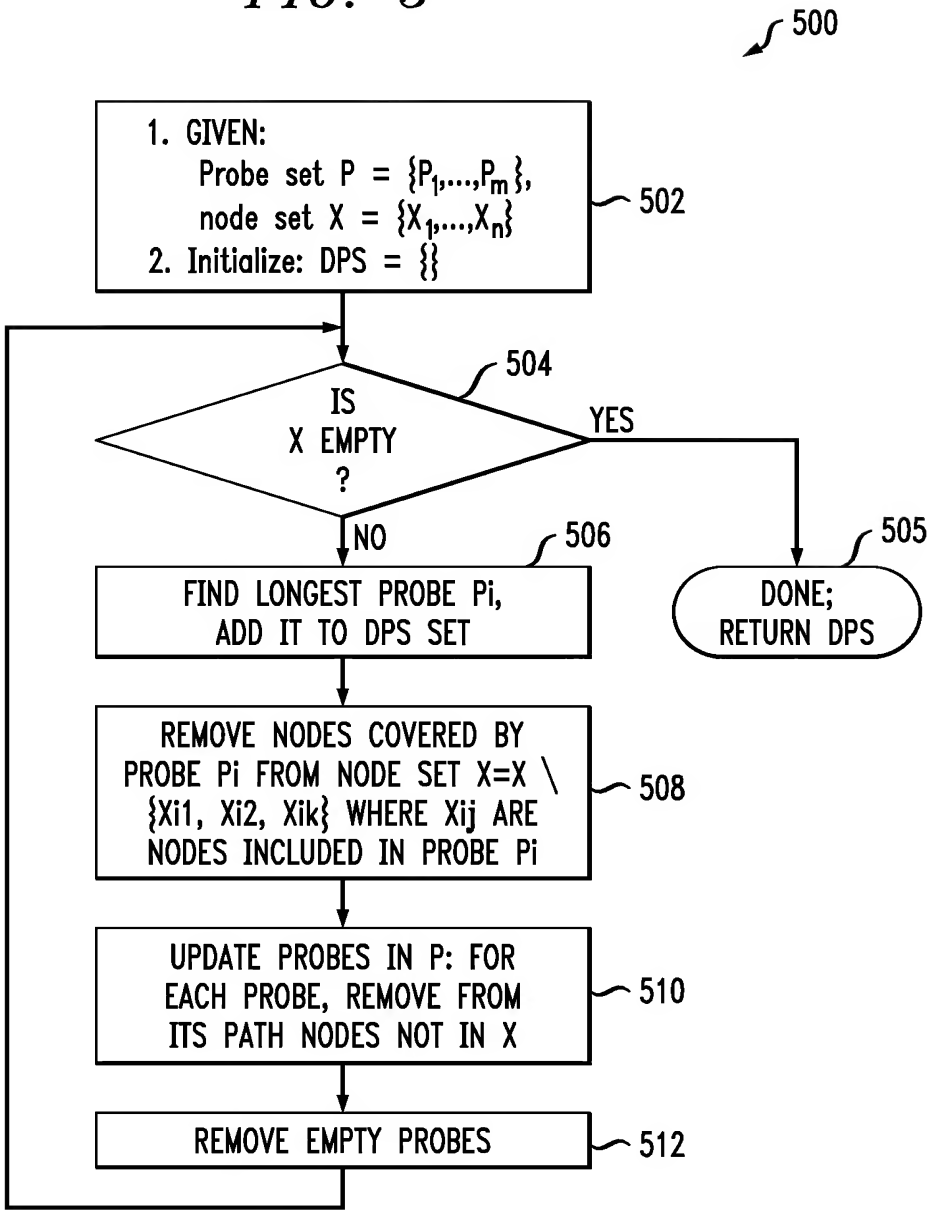
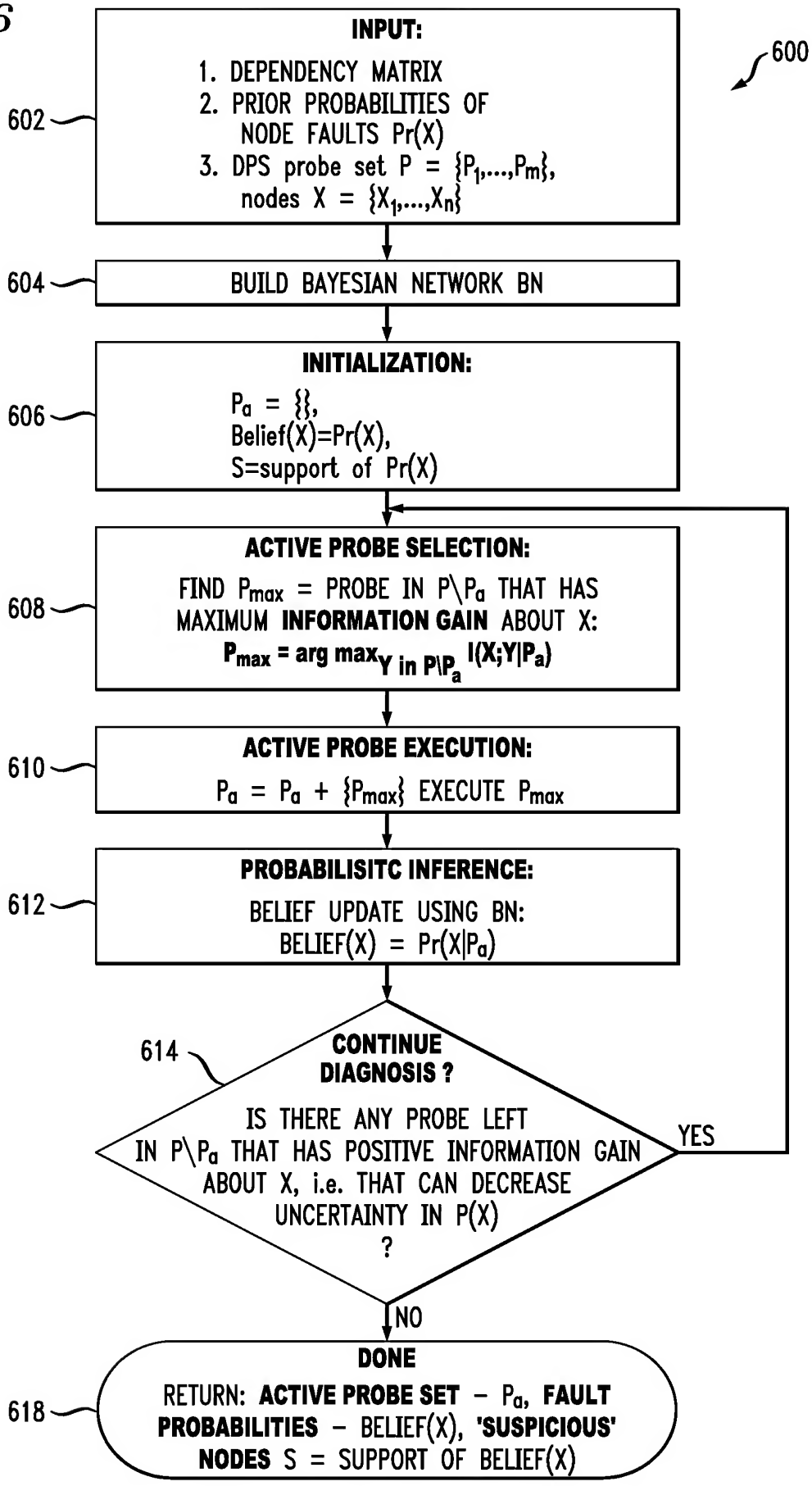

500
1. GIVEN:
Probe set P = {P1,...,Pm},
node set X = {X1,...,Xn}
2. Initialize: DPS = {}
502
504
IS
X EMPTY
?
YES
NO
505
DONE;
RETURN DPS
506
FIND LONGEST PROBE Pi,
ADD IT TO DPS SET
REMOVE NODES COVERED BY
PROBE Pi FROM NODE SET X=X \
{Xi1, Xi2, Xik} WHERE Xij ARE
NODES INCLUDED IN PROBE Pi
508
UPDATE PROBES IN P: FOR
EACH PROBE, REMOVE FROM
ITS PATH NODES NOT IN X
510
REMOVE EMPTY PROBES
512

FIG. 6


600
602
INPUT:
1. DEPENDENCY MATRIX
2. PRIOR PROBABILITIES OF NODE FAULTS Pr(X)
3. DPS probe set P = {P1,...,Pm}, nodes X = {X1,...,Xn}
604
BUILD BAYESIAN NETWORK BN
606
INITIALIZATION:
Pa = {},
Belief(X)=Pr(X),
S=support of Pr(X)
608
ACTIVE PROBE SELECTION:
FIND Pmax = PROBE IN P\Pa THAT HAS MAXIMUM INFORMATION GAIN ABOUT X:
Pmax = arg max Y in P\Pa I(X;Y|Pa)
610
ACTIVE PROBE EXECUTION:
Pa = Pa + {Pmax} EXECUTE Pmax
612
PROBABILISITC INFERENCE:
BELIEF UPDATE USING BN:
BELIEF(X) = Pr(X|Pa)
614
CONTINUE DIAGNOSIS ?
IS THERE ANY PROBE LEFT IN P\Pa THAT HAS POSITIVE INFORMATION GAIN ABOUT X, i.e. THAT CAN DECREASE UNCERTAINTY IN P(X) ?
YES
NO
618
DONE
RETURN: ACTIVE PROBE SET – Pa, FAULT PROBABILITIES – BELIEF(X), 'SUSPICIOUS' NODES S = SUPPORT OF BELIEF(X)

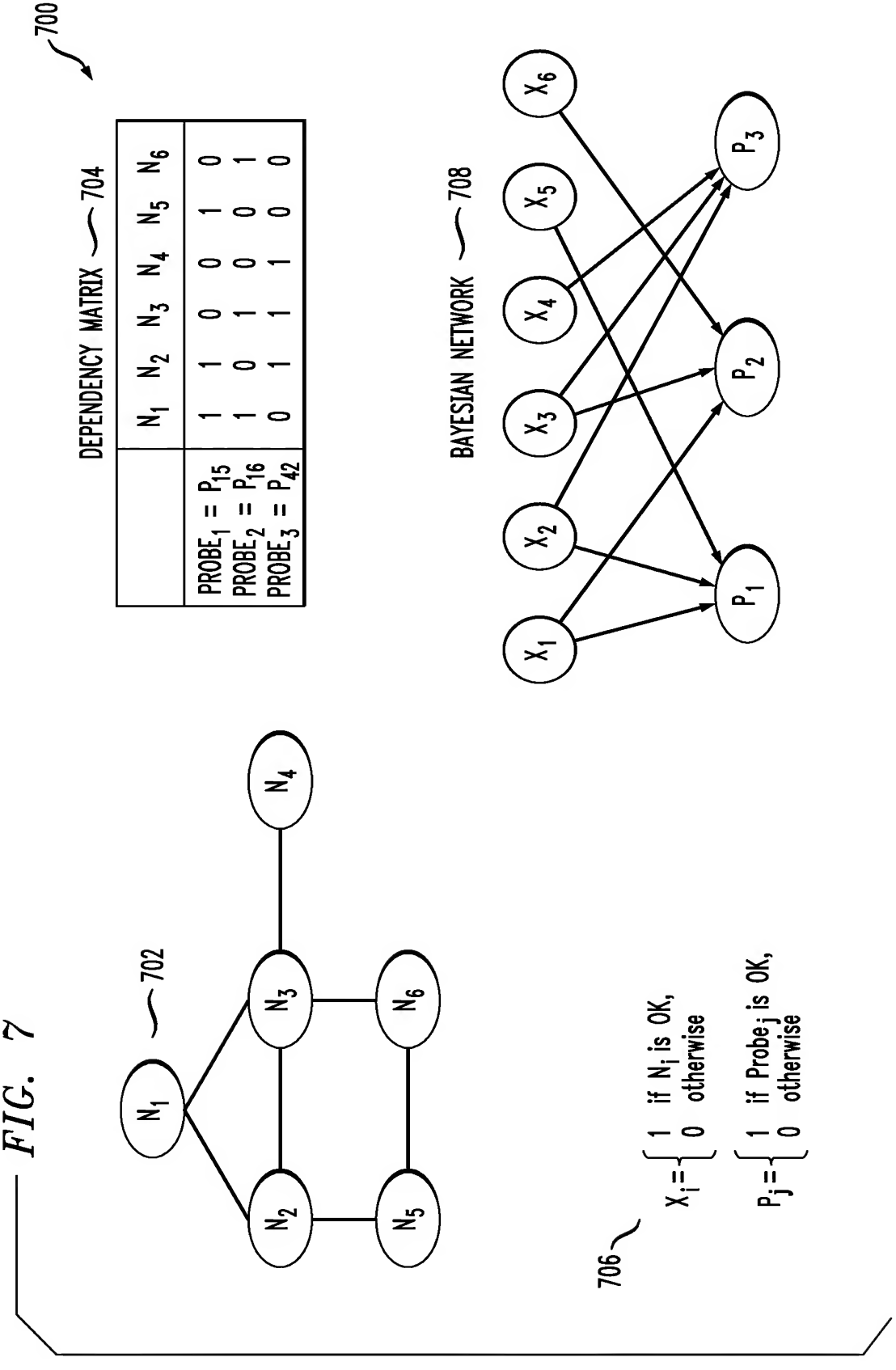

700
DEPENDENCY MATRIX
704
N_1 N_2 N_3 N_4 N_5 N_6
$PROBE_1 = P_{15}$ 1 1 0 0 1 0
$PROBE_2 = P_{16}$ 1 0 1 0 0 1
$PROBE_3 = P_{42}$ 0 1 1 1 0 0
BAYESIAN NETWORK
708
X_1 X_2 X_3 X_4 X_5 X_6
P_1 P_2 P_3
702
N_1 N_2 N_3 N_4 N_5 N_6
706
$X_i = \begin{cases} 1 & \text{if } N_i \text{ is OK,} \\ 0 & \text{otherwise} \end{cases}$
$P_j = \begin{cases} 1 & \text{if Probe}_j \text{ is OK,} \\ 0 & \text{otherwise} \end{cases}$

FIG. 7

FIG. 8

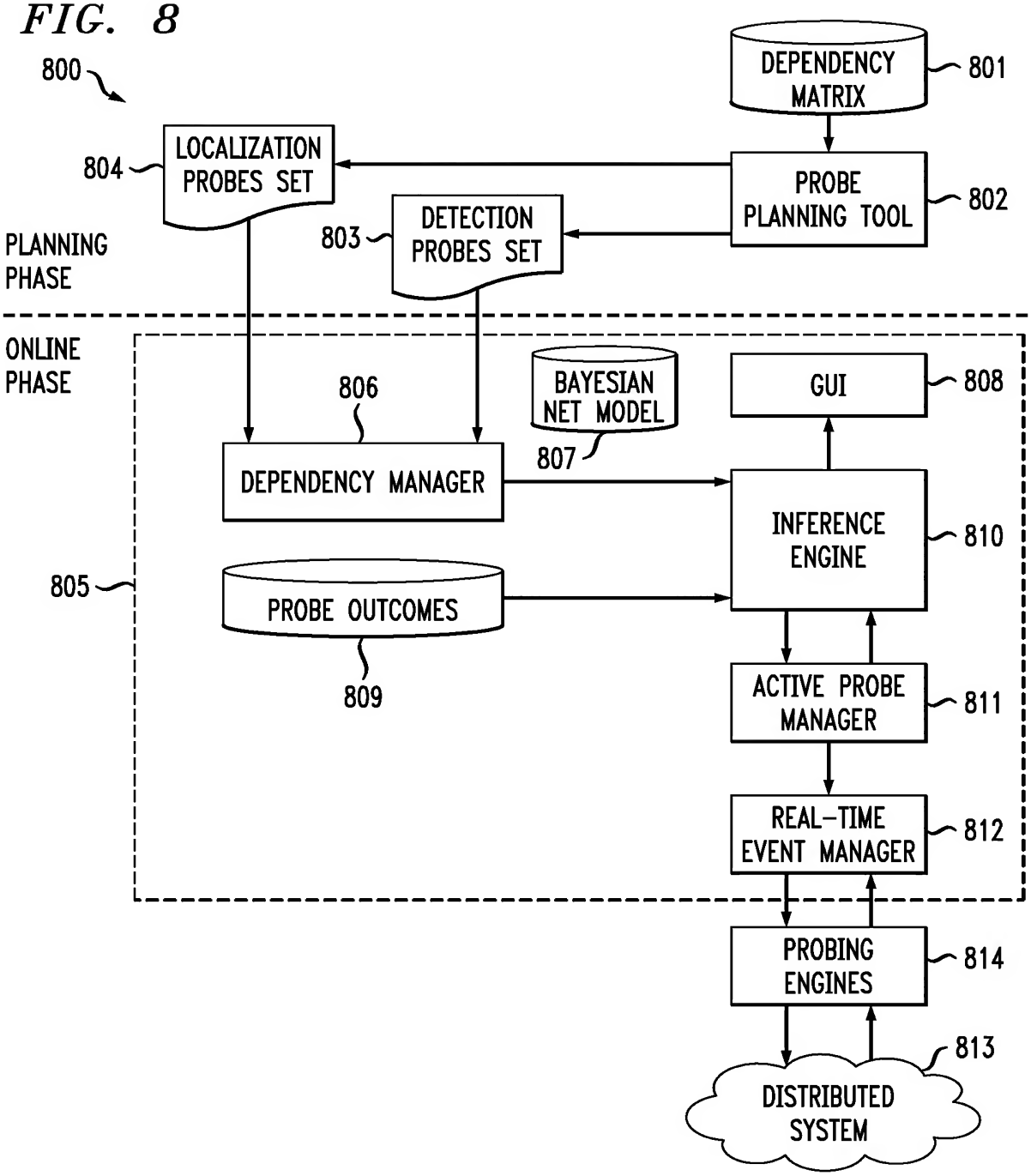
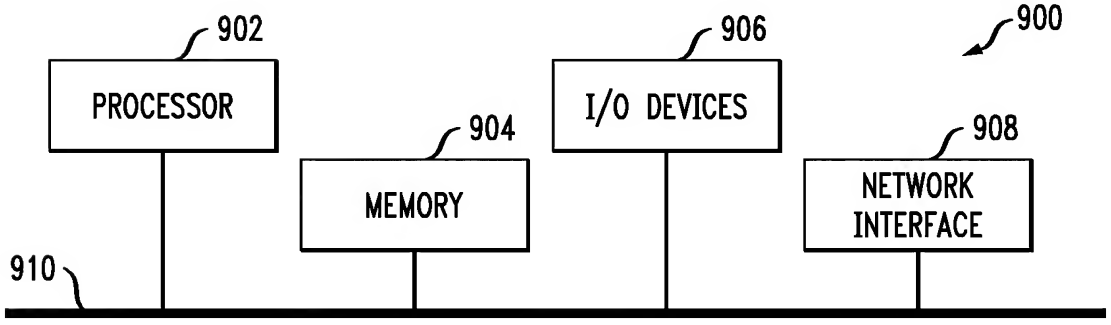

800
DEPENDENCY MATRIX
801
LOCALIZATION PROBES SET
804
PROBE PLANNING TOOL
802
DETECTION PROBES SET
803
PLANNING PHASE
ONLINE PHASE
806
BAYESIAN NET MODEL
807
GUI
808
DEPENDENCY MANAGER
INFERENCE ENGINE
810
805
PROBE OUTCOMES
809
ACTIVE PROBE MANAGER
811
REAL-TIME EVENT MANAGER
812
PROBING ENGINES
814
813
DISTRIBUTED SYSTEM

FIG. 9


902
PROCESSOR
906
I/O DEVICES
900
904
MEMORY
908
NETWORK INTERFACE
910